Questions And Answers For The NLX230 Fuzzy MicroContoller™

INTRODUCTION

The following questions and answers were prepared in responce to numerous inquiries from customers regarding NeuraLogix's NLX230 Fuzzy MicroController (FMC). Detailed information is provided in the NLX230 Fuzzy MicroController data sheet.

Q. What is a Fuzzy MicroController?

A. The FMC is a device which implements in hardware the precepts of Fuzzy Logic Theory to provide control for a wide variety of applications. This hardware implementation enables the FMC to provide smoother and more cognitive control functions at greater speeds and lower cost than other approaches.

Q. What is Fuzzy Logic?

A. Fuzzy Logic is multi-valued logic. Whereas, Boolean Logic has just two values, 0 and 1, Fuzzy Logic values vary from a minimum to a maximum value as a function of the input. Fuzzy logic more nearly matches the approximate nature of human reasoning.

Q. Must I understand Fuzzy Logic Theory to use the FMC?

A. No, because the FMC Development System is so user friendly, it is not necessary for you to be an expert in Fuzzy Theory to design around the FMC. Also since the FMC is not programmed, no new software language is required.

Q. What language is the FMC programmed in?

A. The FMC is not programmed as a conventional Microcontroller would be. Configuring the FMC is accomplished by down-loading a bit map into it. The bit map is easily created by the FMC Development System and can also be generated using any Text Editor.

Q. What is the difference between the FMC and a conventional Microcontroller?

A. The FMC does not require a set of coded instructions to perform its task. Whereas, a Microcontroller processes instructions serially one at a time, the FMC uses parallel processing, resulting in a great increase in speed.

Q. Why use a FMC instead of a conventional Microcontroller and software to implement Fuzzy functions?

A. The over 1200X speed advantage and the low cost of the FMC makes it the preferred method for Fuzzy Logic implementation. The development cycle is reduced and the level of expertise needed is lower with FMC implementation.

Q. What control application is the FMC best suited for?

A. The FMC was designed to yield an efficient implementation of most consumer and industrial applications. These include:

- Automotive Controls
- VCRs and Camcorders
- White Goods
- TV and Audio Systems
- Vacuum Cleaners and Household Appliances
- Building Management Systems
- Applications where other methods were ineffective

Q. What Output functions are available?

A. The output value can be modified in two ways. The action value can be added to a stored initial value, initial values are part of the configuration information downloaded into the FMC. The next action value is added to this same initial value (Immediate Mode). In the Accumulate Mode the action value is added to the initial value and the new value replaces the initial value.

Q. What are the Inputs and Outputs for an FMC?

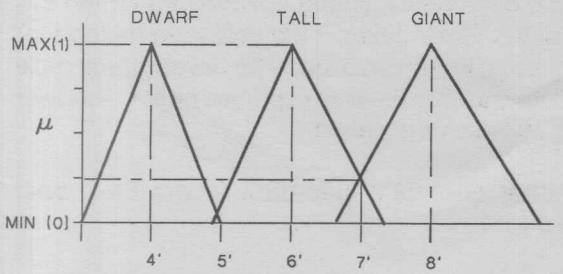
A. The FMC has eight time multiplexed 8-bit digital inputs and outputs. It also receives initial configuration information from a processor bus or EEPROM.

Questions And Answers (Continued)

Q. How is Fuzzy Logic implemented in the FMC?

A. The FMC uses Fuzzifiers to combine inputs with Membership Functions that determine "how well" an input corresponds to a chosen "center value". The corresponding Fuzzy Logic value is normally termed μ (mu). For example, considering the height of people:

let 4ft represent DWARF
let 6ft represent TALL
let 8ft represent GIANT



Membership Functions Example

If a person is exactly 6ft tall, then the Tall Membership Function's μ value evaluates to maximum (1). Mu (μ) for the Dwarf and Giant Membership Functions is minimum (0), since 6ft does not lie in the range of these functions.

Fuzzy Logic "rules" are made up of "terms" combining an input with a Membership Function and an associated "action value" which will modify the output for that rule. Example:

(1) IF InA is Tall AND InB is Giant
THEN Action C
(2) IF InA is Dwarf AND InB is Dwarf
THEN Action D

A winning rule is determined by evaluation all the terms. The minimum term for each rule is chosen. The winner is the rule that contains the maximum of all the chosen minimum terms. The output is modified by the action value of the winning rule. For this example, let InA = 6ft and InB = 7ft. The first term in rule (1) evaluates to μ = 1, the second term to 0.25. Both terms in rule (2) evaluate to zero. The winner is rule (1), so determined because 0.25 > 0. Therefore, action C is performed.

Q. What is a Fuzzifier?

A. A Fuzzifier is a circuit that combines a selected input and a defined Membership Function. The NLX230 contains sixteen Fuzzifiers.

Q. How many Fuzzy operations can an FMC perform?

A. Each FMC has 16 Fuzzifiers that can process 64 rules with a throughput of 30 million rules per second.

Q. How does the FMC perform the defuzzification process?

A. The defuzzification process in the FMC is performed by associating an action with each rule. When a rule is found to be the winner, for a certain input condition, the action associated with it is performed.

Q. Can the FMC be expanded?

A. Yes, by connecting two or more FMC devices together the number of rules, fuzzifiers, inputs or outputs can be increased.

Q. Is the NLX230 the only FMC device?

A. We are currently designing other FMC devices. Some of these contain A/Ds and D/As as well as other peripheral functions. If you have special requirements, contact us and discuss the possibility of NeuraLogix designing a custom device for your application!

If you have any questions concerning this or any of our many other fine products, please contact one of our applications engineers at the address/phone number shown below.

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